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POSTHARVEST AND COLD CHAIN TRAINING NEEDS ASSESSMENT

USAID/GEORGIA RESTORING EFFICIENCY TO AGRI CULTURE PRODUCTION

PREPARED BY: THE WORLD FOOD LOGISTICS ORGANIZATION (WFLO)

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LIST OF ABBREVIATIONS

BSPs	Business Service Providers
CA	Controlled Atmosphere
CV	Curriculum Vitae
GBZ	Georgia Business Zone
GCCA	Global Cold Chain Alliance
HVAC	Heating, Ventilation, and Air Conditioning
ICES	Industrial Construction Engineering Solutions
NRC	Norwegian Refugee Council
REAP	Restoring Efficiency to Agriculture Production
TOT	Training of Trainers
TVET	Technical and Vocational Education and Training
WFLO	World Food Logistics Organization

EXECUTIVE SUMMARY

Background Information

Currently, there is a shortage of qualified professionals who are working in postharvest facilities[1] that have the capacity to effectively handle a growing supply of fruits and vegetable for fresh markets in Georgia. The 2011 USAID's Agriculture Sector Assessment and other surveys stated that the management of cold storage facilities expressed a need for technical support including delivery of training courses in (1) running facilities and in (2) preparing products for proper storage to best serve farmers and their needs.

World Food Logistics Organization (WFLO), the education and technical assistance arm of The Global Cold Chain Alliance (GCCA), has been engaged to develop a series of training courses focused on postharvest technologies and best practices for farmers and cold storage facilities operators under USAID's Restoring Efficiency to Agriculture Production (REAP). WFLO intends to collaborate with local Technical and Vocational Education and Training (TVET) institutions and extension service providers to deliver these courses using a Training of Trainers (ToT) model.

Two WFLO experts, Kerstin Hell (Postharvest Expert), and Richard Dowdell (Cold Storage Engineer and Refrigeration Expert) travelled to Tbilisi from April 6-18, 2014 to: 1) assess local stakeholder knowledge and capacity gaps in postharvest best practices, technology adoptions, and cold chain management; 2) evaluate potential TVET institutional partners; and 3) evaluate and provide technical recommendations to postharvest facility/cold storage operators supported under REAP.

Training Assessment Methodology and Data Gathering

As part of the training needs assessment, WFLO experts met with three (3) grant applicants twice, visited four (4) colleges/universities, eight (8) cold storage facilities, a cold storage contractor, a refrigeration maintenance contractor, a local cold-store wholesale market, and interviewed an applicant who could potentially serve as a local trainer. These visits plus many years of experience in postharvest and cold storage construction and operation are the basis for our recommendations.

Having reviewed the three REAP grant cold storage-related grant applications, WFLO experts believe that the proposals were well put together overall. All applications demonstrated some awareness of what is required to store fruits and vegetables in a cold storage facility, which could be improved through training. They all have good businesses, own orchards, and are expanding their orchards. All applications appeared to have good technical experience within their companies, however there appeared to be a lack of knowledge on proper commodity storage best practices and overall cold chain management best practices. Using cold storage facilities will allow them to extend the shelf life and maintain good product quality, making their business more viable. Cold storage facilities are a good next

[1] For the purpose of this activity, postharvest facilities refer to pack houses, pre-cooling operations, cold stores/warehouses and distribution operations.

step for diversification for the applicants. For these reasons we recommend the applicants be approved for grants as requested.

The WFLO team visited the colleges and universities to determine if their campuses would be good venues for training programs and if they have qualified staff to teach those programs. We identified two (2) vocational colleges and one (1) university that would be good venues for training classes. One university has instructors who have excellent credentials including postharvest training as well as cold storage training.

During the mission, we received 14 CV's from many highly qualified applicants for technical training for both postharvest and cold storage training. We intend to review them all and select the most appropriate trainers for the actual ToT program to take place later this year.

Findings and Recommendations for TOT

As a result of the assessment, we propose to develop a training curriculum featuring modules on: Postharvest Management of Fruits, Harvesting and Handling, Packinghouse Operation, Best Storage Practices, Refrigeration, Facility Design, Cold Storage Operations, and Business and Marketing Practices supported by practical exercises, field and cold store visits. **We recommend that the ToT seminars be given in Tbilisi and Batumi, and should include as participants a mix of trainers and practitioners (farmers, cold store managers, fruit agribusiness managers).** The ToT course will be based on PowerPoint Presentations translated into Georgian. Copies of the PowerPoint presentations will be handed out to all attendees. It is recommended that a certain amount of time is allocated for follow-up visits to the attendee's farms, orchards, or cold storage facilities.

Possible short term consultancies as a follow up to this assignment:

- **Cold Chain Management Training-** this training program builds on the program that is being designed by WFLO that is commodity-specific, focusing on postharvest and refrigeration basics. WFLO's Cold Chain Management short course takes a multi-commodity approach, whereby participants learn how to manage several types of commodities from postharvest, through transport and transit, as well as in the warehouse, all the way to retail distribution.

- **Training for refrigeration engineers.** – In many developing countries, there is often a lack of capable engineers familiar with the type of complex refrigeration systems that are often used in modern cold stores. This program will target in-country HVAC and other engineers who are employed in existing cold stores to training them in ammonia and/or Freon refrigeration maintenance best practices.

- **Onsite consulting for selected project-supported cold storage operators**. WFLO can use its GCCA network of cold storage, transport/logistics, and construction experts to provide hands-on assistance to specific companies supported by the REAP project.

Study tour and educational program- for selected REAP-sponsored cold storage operators who speak English, WFLO recommends a group from REAP to attend one of GCCA's training and educational programs either in the US or Europe (e.g. WFLO Institute or one of its conferences that feature educational forums http://www.gcca.org/wflo-institute-cold-chain-education-training/). Participants will also get an opportunity to tour modern US or European facilities as part of this

program. GCCA has several trainings held each year and the training held by WFLO is just one of these. In addition, GCCA offers multiple online courses featured at affordable prices.

POSTHARVEST AND COLD CHAIN MANAGEMENT TRAINING NEEDS ASSESSMENT

1.1 STATEMENT OF THE PROBLEM

Currently, there is a shortage of qualified professionals who are working in postharvest facilities[2] that have the capacity to effectively handle a growing supply of fruits and vegetable for fresh markets. The 2011 USAID's Agriculture Sector Assessment and other surveys stated that the management of cold storage facilities expressed a need for technical support including delivery of training courses in (1) running facilities and in (2) preparing products for proper storage to best serve farmers and their needs. Moreover, it is critical to also improve skills of farmers in this area because food quality and shelf life preservation begins on the farm where most losses are currently occurring in the food system. As a result, postharvest operators have a keen interest to ensure that farmers are also trained in postharvest management and best practices to improve their supply.

To address the above capacity gaps, the World Food Logistics Organization (WFLO) has been engaged to develop a series of training courses focused on postharvest technologies and best practices for farmers and cold storage facilities operators. WFLO intends to collaborate with local Technical and Vocational Education and Training (TVET) institutions and extension service providers to deliver these courses.

To better serve the global cold chain industry, WFLO is dedicated to providing training and education for the proper handling and storage of perishable products, and the development of systems and best practices for the safe, efficient and reliable movement of food to the people of the world.

1.2 ACTIVITY OBJECTIVES

The overall objective of this assignment was to assess training needs in postharvest handling technologies in order to develop a detailed, in-depth training course on product handling from field to storage, with a focus on stone fruits, pome fruits, citruses, and persimmon that are priority crops in Georgia. Dr. Kerstin Hell, WFLO Postharvest specialist and Richard Dowdell, WFLO Cold Storage Engineer and Refrigeration Expert, travelled to Tbilisi, Georgia from April 6-18, 2014 to carry out the training needs assessment. The principle duties for both experts were to:

- Conduct a rapid assessment of postharvest handling facilities;

[2] For the purpose of this activity, postharvest facilities refer to pack houses, pre-cooling operations, cold stores/warehouses and distribution operations.

- Identify existing postharvest handling practices;
- Potential strategies for improvement;
- Define the most critical issues/problems for which training should be designed;
- Devise strategies for cold storage facilities;
- Meet with vocational colleges/universities that may house training courses in postharvest technologies;
- Identify candidates to serve as local trainers to instruct courses upon completion of the ToT;
- Debrief REAP and REAP COR on findings and next steps to operationalize the training program.
- Work closely with REAP staff to organize and conduct Postharvest Handling Forum for businesses and training providers.

Please find complete SOW for this assignment in **Annex I**.

The main output from this assignment is a Training of Trainers curriculum developed by WFLO to provide details on postharvest best practices with an emphasis on stone fruits, citrus, pome fruits and persimmons. In addition, training modules will be developed for refrigeration basics and postharvest storage facility design to promote proper cold chain management of the commodities mentioned above.

1.3 EVALUATION OF GRANT PROPOSALS

WFLO technical experts met with three potential grantees under the USAID-funded Georgia Restoring Efficiency to Agriculture Production (REAP), and subsequently reviewed their proposals to build and operate small, cold storage facilities in various locations in Georgia. Specifically, WFLO experts reviewed proposed the floor plans, as well as discussed the construction and operation of the new facilities vis-à-vis crop production logistics with Geoflower LTD, Iveria LTD, and Georgia Business Zone. All three companies are well-qualified to receive grants, however REAP will support them to train their post-harvest handling and cold storage specialists (in most of the cases they will have one specialist both in post-harvest handling and cold storage). WFLO proposes that these grantees attend the proposed postharvest and cold chain management training programs to ensure compliance with cold storage operations best practices. Please see **Annex II** for a detailed proposal review and a summary of recommendations provided to each company.

1.4 EVALUATION OF CAPACITY FOR COLD STORAGE CONSTRUCTION AND MAINTENANCE

1.4.1 FACILITY VISITS

WFLO experts visited eight (8) cold storage facilities, two (2) of which would be considered modern cold storage construction. Specifically, visits were made to:

1. Cold Storage in Akhasheni (Kakheti)

Figure 1: Herbia Cold Store

2. Cold Store in Sagaredjo (Kakheti)
3. Bermuki Cold Storage (Shida Kartli)
4. Herbia Cold Storage (Imereti)
5. Cold store with CA rooms in Gori (Shida Kartli)
6. Agroexporti in Batumi (Ajara)
7. Guria ABC in Ozurgeti (Guria)
8. Lilo Cold Storage (Tbilisi)

The cold storage facilities that we visited were built with some basic knowledge of cold storage facility requirements. The cold rooms and refrigeration equipment installations were generally good. But there are many issues with the cold storage facilities. Many of the facilities experienced similar problems – especially pertaining to hygiene and none of the facilities operate all year round, which is a sign that operational efficiency and profit maximization can be improved.

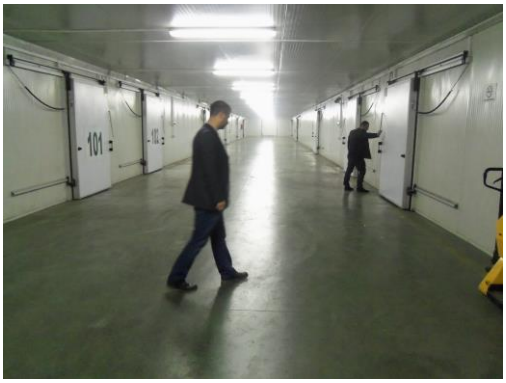

Figure 2: Lilo Cold Storage Facility

Major issues would include the technical knowledge to maintain proper temperatures, humidity, and venting. These problems are easy to address. Lack of pre-cooling for most facilities is a major issue. Pre-cooling is very important to prevent moisture loss and maintain product quality. This is not difficult to correct, but does require some capital investment.

Another major issue is the lack of good docks and the ability to receive and ship products efficiently. This is a matter of both costs and maintaining product quality and requires capital outlays to correct. Overall site selection is a major issue. This is not unusual for an initial facility to be built without planning for the future.

Specific issues will be outlined in **Section 1.6 "Findings".**

1.4.2 CONTRACTOR VISITS

In addition to paying a visit to several cold storage facilities, the WFLO team paid a visit to several cold storage construction/contracting companies. First, the team visited with **Gocha Iakobashvili**, **Commercial Director for Industrial Construction Engineering Solutions (ICES)**. ICES specializes in design/build cold storage construction – they provide complete turnkey services. They have the knowledge to assist owners in layout and floor plans. They use good practices and materials in the cold storage facilities. Gocha has an excellent working knowledge of the requirements for fruit and vegetable storage including temperature and humidity control as well as the need to ventilate rooms that produce ethylene gas. He has a good working knowledge of truck dock requirements and site layout for receiving and shipping products.

We also met with **Mamuka Morchiladze, Technical Director for Climate**. Climate is a refrigeration contractor. They install all the refrigeration systems for ICES. We visited 2 of the cold storage facilities constructed by ICES. The facilities and the refrigeration systems were very good. Climate also has service crews that service and repair refrigeration equipment throughout Georgia.

Most cold storage facilities throughout the world are relatively small and do not have the in-house capabilities to service and repair their refrigeration equipment. It is a standard practice to have service contracts or to contact a refrigeration service contractor for service and repairs. Most countries in this region do not have refrigeration service contractors and are facing refrigeration maintenance problems.

Meetings notes from all site visits and meetings can be found in **Annex III**.

1.5 EVALUATION OF CAPACITY FOR POSTHARVEST TRAINING

1.5.1 VOCATIONAL SCHOOLS AND UNIVERSITIES

We visited 4 vocational colleges and universities engaged in agriculture programs to evaluate their capacity to host and/or provide technical support to carry out the proposed ToT. What follows is a brief summary on each institution.

1. COLLEGE NAME: Aisi

LOCATION: Village Kachreti, Gurjaani region

CONTACT PERSON: Natela Papunashvili

CONTACT INFORMATION: 577557115

VOCATIONAL DIPLOMA PROGRAMS:

- Viniculture
- Viticulture
- Beekeeping
- Veterinary Service
- Fruits/Vegetable Processing

SHORT-TERM TRAINING PROGRAMS:

No	Training Course	Duration	Training cost per person (in GEL)
1	Tractorist- Mechanics	36 days	200 (US$ 113)
2	Fruits/Vegetable Processing	45 days	200 (US$ 113)
3	Animal Sciences	35 days	150 (US$85)
4	Veterinary	35 days	150 (US$85)
5	Vegetable Production/Field Crops	35 days	150(US$85)
6	Viticulture	35 days	150(US$85)

7	Feed Management	35 days	150(US$85)
8	Viniculture	35 days	200(US$ 113)
9	Beekeeping	35 days	200(US$ 113)

FACILITY DESCRIPTION in BRIEF:

The Aisi college campus that is located on 12 ha in village Kachreti includes a well refurbished and equipped classroom building, fruit/vegetable processing mini factory, chemical lab, small-scale fruit dryer, dairy teaching farm, wine house, vineyard, demonstration plot, hostel and guesthouse with conference facilities. The college does not have the proper reaching equipment for tractorists-mechanics courses. Aisi was a subcontractor for the GoG implementing training courses for tractorists and were using tractors and other equipment owned by Mekhanizatori to offer these training programs.

KEY CLIENTS in LAST 3 YEARS:

- 800 tractorists-mechanics were trained for Mekhanizatori, ltd.
- 21 municipality agronomists
- 6 plant protection specialists for extension service

FARMER INFORMATION-EXTENSION CENTER:

Since its establishment in 2008, the Farmer Information-Extension Center conducted numerous consultations/projects in 5 rayons of Kakheti region (Sagarejo, Gurjaani, Signagi, Dedoplistskaro, and Lagodekhi):

- 1799 group consultations attended by 21,228 farmers
- 372 field consultations attended by 5611 farmers
- 967 farmers received individual consultations
- 156 field days were arranged
- 116 demonstration plots were arranged
- 400 farmers trained in different aspects of agriculture.

In September, 2013 the farmer information-extension service groups were set up in 5 rayons of Kakheti region.

EMPLOYMENT STATICTICS:

In 2011 – 65% of college graduates

In 2012- 59% of college graduates

2. COLLEGE NAME: Gantiadi

LOCATION: Gori

CONTACT PERSON: Otar Dabrundashvili

CONTACT INFORMATION: 577900411

VOCATIONAL DIPLOMA PROGRAMS:

- Horticulture
- Fruits/Vegetables Processing
- Melioration
- Milk Processing
- Tractorist
- Veterinary

SHORT-TERM PROGRAMS:

No	Training Course	Duration	Training cost for person (in GEL)
1	Horticulture	240 hours	240 (US$ 135)
2	Fruits/Vegetable Processing	200 hours	255 (US$144)
3	Melioration	200 hours	250(US$ 141)
4	Milk Processing	200 hours	240(US$ 135)
5	Tractorist	200 hours	294 (US$166)
6	Veterinary	200 hours	276 (US $156)

FACILITY DESCRIPTION in BRIEF:

The college is located in Gori and its academic building has well-equipped classrooms, chemical laboratory and other teaching labs. It operates a mini milk-processing teaching factory that constructed with UNDP financial assistance. In village Khidistavi the college owns another academic building, fruit demonstration plot, and machinery for tractorists' trainings.

KEY CLIENTS in LAST 3 YEARS:

Short-term training courses in fruits growth, milk processing, and agriculture machinery (tractorists) were provided to farmers with support of Norwegian Refugee Council (NRC), USAID's New Economic Opportunities Initiative (NEO) activity, and the United Nations Development Program (UNDP.

3. COLLEGE NAME: Akaki Tsereteli State University

LOCATION: № 59, Tamar Mepis str., Kutaisi

CONTACT PERSON: Ketevan Kintsurashvili

CONTACT INFORMATION: 577243334

VOCATIONAL DIPLOMA PROGRAMS:

- Agronomy
- Citrus Fruits Agrotechnologies
- Agriculture Machinery Service
- Agrologistics
- Fruits/Vegetables Storage and Processing

SHORT-TERM PROGRAMS:

No	Training Course	Duration	Training cost for person (in GEL)
1	Agronomy	3 weeks	300 (US $169)
2	Citrus Fruits Agrotechnologies	2 weeks	200 (US $ 113)
3	Agriculture Machinery Service	3 weeks	300(US $169)
4	Agrologistics	3 weeks	300(US $169)
5	Tea and Tea Degustation	2 weeks	200 (US $ 113)
6	Fruits/Vegetables Storage and Processing	3 weeks	300(US $169)

FACILITY DESCRIPTION in BRIEF:

The university has 20-ha demonstration plots in Gugeti and Nosiri with the following crops planted on them: hazelnut, citruses, persimmon, bay, feijoa, and annual plants. The university has agrochemical, biochemical, citrus fruits laboratories, plant nursery, agricultural machinery teaching workshop, and 3 computer classrooms.

KEY CLIENTS in 3 LAST YEARS:

The university started a delivery of short-term agricultural courses last year and they were mainly attended by individuals engaged in agriculture from Imereti and Samegrelo regions.

4. COLLEGE NAME: Batumi Shota Rustaveli State University

LOCATION: N35, Ninoshvili str., Batumi

CONTACT PERSON: Merab Megrelidze

CONTACT INFORMATION: 555741143

VOCATIONAL DIPLOMA PROGRAMS:

- Agricultural Machinery Service
- Refrigerator Service
- Food Products Processing and Canning Technologies

SHORT-TERM PROGRAMS:

No	Training Course	Duration	Training cost for person (in GEL)
1	Tractorist	1 month	134 (US $76)
2	Irrigation and Drainage	1 month	134(US $76)
3	Agriculture Machinery Service	1 month	134(US $76)
4	Agriculture Water Supply Systems	1 month	134(US $76)
5	Refrigerators and Refrigeration Technologies	1 month	134(US $76)
6	Food Products Processing and Canning Technologies	1 month	134(US $76)

FACILITY DESCRIPTION in BRIEF:

The university agricultural college campus that is located on 25 ha in village Mtsvane Kontskhi includes an academic building with classrooms, library, computer class, mechanization, plant protection, and soils labs. The college has an agricultural machinery workshop with 2 T-40 type tractors, 2 Super model mini tractors, and mini grass movers. The college demonstration plot's total area is 24 ha, target crops being citruses.

KEY CLIENTS in LAST 3 YEARS:

The college has been cooperating with USAID's project for 3 years to provide hazelnut trainings to farmers.

1.5.2 INDIVIDUAL LOCAL CONSULTANTS/TRAINERS

We interviewed one consultant, Albert Machaberidze, who could serve as a local postharvest trainer. He had solid formal education training with excellent job experience and he is well qualified to instruct harvest and postharvest classes. During the interview we learned that he was committed to another assignment for about 8 months, so he is not a viable candidate.

Since having drafted this document, WFLO has received 14 Curriculum Vitaes (CV's) of potential trainers. There appear to be several highly qualified applicants to select from for both postharvest and cold storage training delivery. WFLO and REAP staff will review the CV's and provide comments and recommendations on the most appropriate people to take the ToT, and subsequently serve as local trainers during the months of June and July.

1.6 FINDINGS

During site visits, WFLO experts organized their observations into three main areas: 1) Postharvest; 2) Storage; 3) Business (Operations) and Marketing.

1.6.1 POSTHARVEST

Figure 3: Roadside Market

Major postharvest-related observations from the site visits include:

- Lack of right variety for market – maturity, organoleptic quality, yield
- Lack of knowledge on correct fertilization, irrigation and pesticide and timing
- Little knowledge about correct maturity index
- Proper harvesting practices containers, shading
- Rarely sorting and grading
- Lack of hygiene and good management
- Seldom pre-cooling;
- Mostly cellar storage, rarely cold storage
- Each producer does his own marketing
- Generally poor organoleptic quality of products – varietal improvement?
- No specific packaging mostly in crates
- Losses were specified to be up to 50% and more

1.6.2 COLD STORAGE

Critical Cold Storage issues generally fall into 3 major categories. The following lists outline the major issues noted by the WFLO team:

- Cold Storage Room Conditions
  - Temperature control
  - Humidity control
  - Ventilation of ethylene gas
  - Lack of knowledge of proper temperature and humidity requirements for various products
  - Need to establish operating procedures
- Sanitation
  - Insufficient water system to properly clean and sanitize
  - Rough concrete floors and surfaces that cannot be easily cleaned
  - Poor toilet conditions and lack of hand washing stations for employees
  - Trash inside and outside of facilities
  - Personnel not trained in sanitation and maintenance
- Cold Storage Facilities
  - No pre-cooling
  - Facilities not designed to properly store products
  - Poor layout and floor plans
  - No separate or poorly designed docks
  - No refrigerated docks

- Improper dock heights to facilitate receiving and shipping products
- Insufficient doors, types, and quality of doors
- Insufficient access for trucks

1.6.3 BUSINESS AND MARKETING

Critical business and marketing issues **observed** include:

- Lack of a clear business plan
- Lack of diversity of products stored to be able to operate around the year
- Lack of a sorting equipment and procedures
- Lack of operating procedures and training
- Lack of a training for suppliers of products
- Need to establish good working relations and contracts with firms that provide refrigerated truck services

- Marketing
  - Need improved packaging
  - Need to establish "brand quality"
  - Need to establish quality control procedures that will enable products to be exported at higher prices
  - Need to establish trading partners to export products

1.7 RECOMMENDATIONS AND FOLLOW-UP ACTIVITIES

The following summarizes the proposed context for the postharvest and cold chain management training programs based on the needs assessment and capacity evaluation:

1.7.1 PROPOSED TRAINING OUTLINE

* NOTE: The outline below provides a general overview of the principles to be covered during the training. For this particular program in Georgia, WFLO will place emphasis on stone fruit, citrus, apples and other pome fruit, as well as persimmons.

Proposed WFLO Outline of training program: Georgia REAP

There are two modules associated with this training: 1) Postharvest Best Practices; 2) Refrigeration and

1st day	2nd day	3rd Day	4th Day	5th Day
Postharvest Overview	**Harvest, harvesting tools and field packaging**	Postharvest of apples	Refrigeration Basics Overview	Refrigeration Facility Design (continued from previous day
	Demonstration of harvesting tools	Demonstration of starch-iodine test	Demonstrations	
Group discussion- problem analysis of postharvest value chain in Georgia - brainstorming Do the ranking of top 10 priorities	**Sorting and grading:** **Effects on postharvest shelf life**	Postharvest of citrus		Cold Storage facility visits- GCCA member visit to facility at Port of Poti (modern
Fresh product quality parameters	**Exercise** in sorting and grading	Postharvest of stone fruits	Refrigeration Facility Design	Cold Storage facility visits- up to 3
Exercise How to use refractometer How to use penetrometer	**Packinghouse operations:** **Effects on postharvest shelf life**	Decay and Insect control		
	Visit to packinghouse	Visit to orchard		

Cold Storage Facility Design. The following provides and outline of what is to be covered in each module.

Module 1: Postharvest Best Practices

This module will be comprised of sections that will focus on postharvest best practices and technology prescriptions for stone fruits (cherries, nectarines), citrus, persimmon and kiwi. Topics to be covered in this section may include:

Postharvest overview

- Production Good Agricultural Practices GAP
- Irrigation, fertilization
- Quality characteristics for storage – size, maturity etc.
- Training of collectors – what quality needed
- Avoiding damage/maintaining quality
- What are postharvest losses/causes
- Postharvest Losses and Profits

Harvesting

- Harvesting and preparation for storage
- Harvest index maturity and compatibility of products
- Containers for harvesting
- Tools for harvesting
- How to harvest - Cutting, Cooling, prepare for storage
- Curing roots, tubers and bulb crops
- Washing
- Transport to storage facility – technologies

Packinghouse operations

- Narrow pallet system
- General operations
- Packinghouse layout
- Dumping
- Conveyor equipment
- Washing ; Waxing; Sorting; Sizing
- Simple packing line

Packing and packaging materials

- Packing practices
- Packing containers
- Choosing a container
- Packaging practices
- Labeling
- Modularization of containers
- Modified atmosphere packaging (MAP)
- Unit loads

Decay and insect control

- Chemical controls
- Cold treatments
- Controlled/modified atmosphere treatments
- Heat treatments
- Biological control and plant growth regulators

Storage of horticultural crops

- Recommended storage temperatures
- Compatibility groups for storage
- Susceptibility to freezing injury
- Storage practices
- Storage structures
- Storage of fruit and vegetable crops
- Controlled atmosphere (C.A.) storage

Food Safety Practices

- Food Safety on the Farm
- Minimizing pathogen contamination during harvest
- Minimizing pathogen contamination during Postharvest Handling
- Sanitizing field containers, tools and packinghouse surfaces
- Traceability
- GLOBALGAP and HACCP
- Current trends in International Food Trade Rules.

1.7.2 REFRIGERATION TRAINING MODULE

The refrigeration training module will include but is not limited to the following:

- Need for refrigeration
- Methods of postharvest pre-cooling
- Relative humidity
- Vapor pressure
- Transpiration
- Respiration
- Benefits of cold storage
- Fruits and vegetable storage conditions
- Controlled Atmosphere storage conditions
- Refrigeration basics
- Refrigeration components
- Refrigerants
- Refrigeration heat loads
- Insulation materials
- How to measure temperatures and calibrate thermometers
- How to measure humidity and calibrate equipment

1.7.3 FACILITY DESIGN TRAINING MODULE

The facility design training module will include but is not limited to the following:

- Design phase
- Site selection
- Floor plans
- Docks

- Process rooms
- Pre-coolers
- Offices
- Employee welfare area

1.7.4 COLD STORAGE OPERATIONS TRAINING MODULE

The cold storage operations training module will include but is not limited to the following:

Good operating practices
Sanitation
Equipment
Inventory procedures
Material handling
Product handing
Maintenance procedures

1.7.5 BUSINESS AND MARKETING TRAINING MODULE

It was identified that the **grant recipients** will need training in business and marketing which needs to include but is not limited to the following:

Business models
Product diversification
Sorting and grading
Packaging
Meeting export requirements
Transportation
Equipment

We recommend seminars to be given in Tbilisi and Batumi. The seminars would be PowerPoint Presentations based on the training program modules outlined above. This will provide an opportunity for the selected technical training consultants and practitioners to become familiar with the training programs. The customized PowerPoint presentations in the Georgian language will be shared. Copies of the power point presentations will be handed out to all attendees.

It is difficult for many to ask questions in a seminar setting. It can also be difficult to relate questions to their specific applications. Therefore it is recommended that a certain amount of time be allocated for follow-up visits to the attendee's farms, orchards, or cold storage facilities. It would be reasonable to expect 6 or 8 requests for visits. This is an excellent opportunity to provide direct help. It has worked well in other countries.

1.7.6 RECOMMENDATIONS FOR PROPOSED GRANTEES

Iveria, Ltd:
Iveria owns over 19 hectares of land and has made a very large investment in orchards including a high density orchard. They are currently installing a modern irrigation system. In 2014, they will purchase and

sell apples. In 2015 they will sell their own apples along with purchased apples. In 2016 and 2017 they will reach full harvest from their orchards.

Iveria has an excellent site for their orchards and a planned 250 MT cold storage facility with 4 cold rooms and a process room. They have selected an experienced cold storage contractor to build the facility. They have a good water supply, have installed a 10 kW power line to the property, and an excellent access road.

In our review of the Iveria proposal, we made comments and recommendations on training, the proposed floor plan, and refrigeration information. In addition in **Annex IV,** we have provided specific storage information for apples.

Iveria is developing excellent orchards and has a good business plan. A cold storage facility will support their operations. It will allow them to market products more efficiently. Iveria is an excellent choice to receive a grant to assist in the financing of a cold storage facility.

Georgia Business Zone, Ltd:
Georgia Business Zone (GBZ) owns a dairy and has planted 3.5 hectares of apples. They expect to harvest 30 tons of apples in 2014 and 180-200 tons of apples by 2016. One of the founders is an experienced agronomist. There are also an agronomist, 2 well trained agriculture staff members, and an experienced seasonal harvest team. They have good experience in orchard management including applying fertilizers and pesticides. They own a nursery and will expand the apple orchards from the nursery stock.

GBZ is ISO and HACCP certified. The Georgia Chamber of Commerce of Industry and Trade awarded GBZ the Best AgriFirm among small and medium enterprises in 2010. They currently market products to a substantial list of customers. These established customers will provide a good market for their apples.

GBZ plans to build a 180 ton cold storage facility with 3 storage rooms and a combination dock and processing room. The company has a good source of electricity and 2 wells on their site.

In our review of the GBZ proposal, we have made comments and recommendations on the proposed floor plan, and refrigeration information. In addition in Annex 1, we have provided specific storage information for apples.

Georgia Business Zone has a well-established business and they are developing excellent orchards. They have a good business plan and the cold storage facility will help them grow their business. GBZ is an excellent choice to receive a grant to assist them in the financing of a cold storage facility.

1.7.7 RECOMMENDATIONS AND FOLLOW-UP ACTIVITIES FOR THE 3 COLLEGES AND UNIVERSITIES VISITED:

Kachreti Vocational College
The facilities and location are very good. The school would be a good venue for postharvest training classes. The use of a technical training consultant is recommended. There are not many cold storage facilities in the area. This may not be a good venue for cold storage training. A survey of local cold storage facilities should be made to determine how many students would be interested in cold storage training.

Gantiadi Vocational College
The facility and location are very good. It would be a good venue for both postharvest and cold storage training. After training programs have been prepared and approved, it would be good to review the training programs with Gantiadi. Possible instructors should be interviewed. Technical training consultants, who have submitted CV's, should be interviewed also. The best qualified training consultants should be selected.

Akaki Tsereteli State University
The facility is good and it is located in a large farming area. The instructors have excellent credentials including postharvest training, electrical, and refrigerator and air conditioning equipment. The university has the capability to provide complete training on postharvest and refrigeration systems. The university should provide the training unless it is determined to hire technical training consultants to do all the training.

Batumi Shota Rustaveli University
The facility is in a remote location and appears to be used very little. We do not know if the university has the capability to provide the required training. This is not a good venue for postharvest and cold storage training programs. We do not recommend that this venue to host the training course during the first round of training, but could host a training course when ToT have been chosen and trained. They also need to identify industry partners in their vicinity who work in fruit production and processing, and have a functioning cold store which could host the practical sessions..

1.7.8 PROPOSED FOLLOW UP ON ADDITIONAL STTA FOR COLD CHAIN CAPACITY BUILDING

In addition to the Training of Trainer program prescribed as an output from this assignment, the following are ideas of proposed activities that should be considered by the REAP project as compliment to the ToT:

- **Cold Chain Management Training-** this training program builds on the program that is being designed by WFLO that is commodity-specific, focusing on postharvest and refrigeration basics. WFLO's Cold Chain Management short course take a multi-commodity approach, whereby participants learn how to manage several types of commodities from postharvest, through transport and transit, as well as in the warehouse, all the way to retail distribution.

- **Training for refrigeration engineers.** – In many developing countries, there is often a lack of capable engineers that are familiar with the type of complex refrigeration systems that are often used in modern cold stores. This program will target in-country Heating Ventilation and Air Conditioning (HVAC) and other engineers who are employed by existing cold stores to training them in ammonia and/or Freon refrigeration maintenance best practices.

- **Onsite consulting for selected project-supported cold storage operators**. WFLO can use its GCCA network of cold storage, transport/logistics, and construction experts to provide hands-on assistance to specific companies supported by the REAP project.

- **Study tour and educational program-** for selected REAP-sponsored cold storage operators who speak English, WFLO recommends a group from REAP to attend one of GCCA's training and educational programs either in the US or Europe (e.g. WFLO Institute or one our conferences that feature educational forums http://www.gcca.org/wflo-institute-cold-chain-education-training/). Participants will also get an opportunity to tour modern US or European facilities as part of this program.

ANNEXES

ANNEX I: ACTIVITY SOW

1. BACKGROUND:

To ensure that farmers and processors meet market demand for fruits and vegetables in both local and export markets, it is necessary to have an adequate postharvest handling system and procedures in place by pre-cooling, pack house and other storage facilities in Georgia. Currently, there is a shortage of qualified professionals who are working in postharvest facilities[3] that have the capacity to effectively handle a growing supply of fruits and vegetable for fresh markets. The 2011 USAID's Agriculture Sector Assessment and other surveys stated that management of cold storage facilities expressed a need for technical support including delivery of training courses in (1) running facilities and in (2) preparing products for proper storage to best serve farmer and their needs. Moreover, it is critical to also improve skills of farmers in this area, for food quality and shelf life preservation begins on the farm, where most losses are currently occurring in the food system. As a result, postharvest operators have a keen interest to ensure that farmers as also trained in postharvest food preservation best practices to improve their supply.

To address the above capacity gaps, REAP plans to develop a series of training courses focused on postharvest technologies and best practices for postharvest facilities and farmers. To design and deliver these training courses, in collaboration with local TVET institutions and extension service providers, REAP plans to engage its sub-contractor, the World Food Logistics Organization (WFLO) that is a non-profit affiliate of The Global Cold Chain Alliance. To better serve the global cold chain industry, WFLO is dedicated to providing training and education for the proper handling and storage of perishable products, and the development of systems and best practices for the safe, efficient and reliable movement of food to the people of the world.

2. OBJECTIVES:

The overall objective of this assignment is to assess training needs in postharvest handling technologies in order to develop a detailed, in-depth training course on product handling from field to storage, with a focus on stone fruits, pome fruits, citruses, and persimmon that are priority crops in Georgia.

Specifically, the WFLO consultant who will carry out several site visits to current postharvest facilities to understand current operational capacity and training needs, as well as meet vocational colleges/universities, extension agents and business service providers (BSPs) offering agriculture training courses from a list provided by REAP that could help to facilitate an in depth training on postharvest best practices using a training of trainers model. Once developed, the training program will be translated and delivered in the Georgian language.

[3] For the purpose of this activity, postharvest facilities refer to pack houses, pre-cooling operations, cold stores/warehouses and distribution operations.

This consultancy is one of several that will lead to operationalization of sustainable training programs on modern postharvest handling technologies in the Georgian language including capacity building of local trainers.

3. PRINCIPAL DUTIES AND RESPONSIBILITIES:

- Conduct a rapid assessment of postharvest handling facilities to identify existing postharvest handling practices and potential strategies for improvement (visits to be made to at least 6 facilities including pack houses, pre-cooling operations, cold storage etc.)

- Define the most critical issues/problems for which training should be designed and on which future technical assistance should be focused.

- Devise strategies to make these cooling facilities into fee based service centers for the agricultural sector

- Meet with vocational colleges/universities and BSPs that might house training courses in postharvest technologies and evaluate their capacity to deliver the postharvest training once developed

- Identify candidates for dispensing TOT training courses from the above organizations.

- Debrief REAP and REAP COR on findings and next steps to operationalize the training program.

- Work closely with REAP staff to organize and conduct Postharvest Handling Forum for businesses and training providers.

4. Meetings Related to Understanding and Performing the Work.

The BSPs Capacity Strengthening Consultant shall meet, but is not limited to, the following individuals or groups of individuals in order to fully understand and perform the work specified under this Consultancy:

5. DELIVERABLES:

- Report including assessment results, TVET/extension partner selection analysis, and outline of potential training program.

- Training program on postharvest best practices and relevant technologies with a focus on stone fruits, pome fruits, citruses, and persimmon to be translated into Georgian language.

- Trip Report

ANNEX II: REVIEW OF REAP GRANTEE PROPOSALS

On April 9, 2014, WFLO technical experts met with three potential grantees under the USAID-funded Georgia Restoring Efficiency to Agriculture Project (REAP), and subsequently reviewed their proposals to build and operate small, cold storage facilities in various locations in Georgia. Specifically, WFLO experts reviewed proposed the floor plans, as well as discussed the construction and operation of the new facilities vis-à-vis crop production logistics. The following paragraphs summarize the technical experts' review findings and recommendations for the three grant recipients:

Geoflower, Ltd:

The project proposal is well written, very exhaustive, and includes relevant information. It demonstrates an awareness of what is required to store fruits in a cold storage facility, and how to develop a proposed business. Cold storage of fruits is an excellent business opportunity to diversify Geoflower's service offerings, which currently includes fruit and medicinal processing, mainly for the tea market. Geoflower has already invested in ISO and organic certifications. Steady benefits of these certifications can be expected. Furthermore, they have a European partner who will eventually help them to access more remunerative markets.

Geoflower's existing fruit washing and quality inspection lines can be used for processing fruits to be stored in the cold storage facility. The proposed facility needs access to clean water for processing and washing. The use of products like bleach for disinfection may be considered, while ozone or ultraviolet lights can be used to disinfect products.

The company plans to store apples and plums initially. These products are compatible with each other in storage. Ideal temperatures for both are -1°C to 1°C, relative humidity should be 90% to 95%, and both are ethylene sensitive, so there is need for ventilation so that ethylene levels will not become too high.

It will be best to do the sorting of products on the farm or at the collection points, prior to purchasing so that only good quality products will be bought. In this case transport logistics will be up to the company, with added cost. If purchasing is done at the factory, plans should be made for the use of the rejected product – such as selling to local markets or processors. The storage of products prior to processing will need the same postharvest care as goods that will be stored in long term storage, so that some storage capacity needs to be allocated for this. **They should also provide training for the producers on how to produce good quality apples, so that rejection rates will decrease.** Purchased products need to be properly packaged and crated to reduce damage so that postharvest quality and storability is guaranteed.

Geoflower can utilize their existing markets for the apples and plums. The type of packaging material used to store and market the apples is important. Quality and hygiene of packaging material during storage are key to maintaining quality. By maintaining proper product temperatures and humidity, and storing only good quality fruit, the company will be able to sell fruit at a premium price in the local markets and establish brand recognition.

Sustainability of long term supply of the products should be ensured by gradually converting from a mainly collection-based raw material procurement to eventually plantations for raw materials potentially using an out grower scheme.

Training of the company internal staff which is done twice a year in postharvest product management and cold storage operation, should be extended to suppliers and collectors of raw materials so that they are knowledgeable about the quality characteristics of a good quality Geoflower product and how to attain it. The cold storage facility will require additional labor during the harvest season, but less to operate and maintain the facility for the remainder of the year. The company is well positioned to source the additional seasonal labor that is required.

The facility should be designed so that it can be easily expanded. It is very likely that after Geoflower has operated the facility for a few years and gained valuable experience, they will want to expand. This expansion-vision should be included at the start. Geoflower presented a good floor plan for the cold storage facility. Comments are:

- The cold storage room will be constructed with 1000 mm thick urethane panels for the walls and ceiling – which is very good;
- The walls should be on the exterior of the columns on the exterior walls as shown on the drawings. For the interior partition wall, the columns should be on the inside of the cold storage room also – to allow for door installation;
- Rather than using a swing type door to access the room, it is recommended that a manual horizontal sliding door should be used. The door should be wide enough to allow palletized products to be moved in and out of the room with either pallet jacks or a small fork lift. It is recommended that a good quality strip curtain will be installed on the door to prevent loss of cooling, and that this curtain will be replaced when individual strips are damaged or lost;
- If boxes or crates are to be hand carried in and out of the cold storage room, a swing type door as currently shown on the floor plan, should be installed in addition to the horizontal sliding door.;
- It is important to install a commercial humidity control system that is easy to maintain. Maintenance and calibration instructions should be provided with the humidifier. The system will require clean filtered water;
- Apples produce ethylene gas. It is absolutely necessary to install an ethylene gas vent system at the ceiling or use an ethylene gas removal system. Ethylene gas levels must be monitored regularly.

Geoflower is in the process of selecting a refrigeration equipment supplier. The following information should be provided to the refrigeration supplier for proper design of the refrigeration system:

- Length, width, and height of the room and the thickness of the urethane insulated panels
- Size and types of doors and if strip curtains will be used
- Product information
  - Apples, plums, and other products that will eventually be stored
  - Room temperature and humidity requirements (see above)
  - Temperature of incoming product during harvest
  - How much product will be coming into the room daily during harvest
  - If pre cooling will be done inside the room, the supplier will need to know how much product will be pre cooled daily
  - The supplier shall train a Geoflower employee on preventative maintenance and should provide a written preventative maintenance schedule and procedures for each piece of equipment.

Iveria, Ltd:

Iveria owns two land plots totaling over 19 hectares in the Gori District, next to a good asphalt paved road. They have made a very large investment in the orchards and are using good varieties. In 2011, Iveria planted 5970 apple transplants which in the 5th and 6th years will produce a full harvest. They have

also planted one hectare of high density orchard – a modern orchard technique with a much earlier production, higher yields per hectare and lower costs for orchard management.

WFLO visited the new Iveria orchard. At the time of the visit, they were installing a modern irrigation system. This is also the site of the new cold storage facility. It is an excellent site that has a good road. They have installed a 10 kW power line to the property.

Iveria plans to construct a 250 MT cold storage facility that will have four storage rooms. It is a good strategy to build small rooms as this will allow for flexibility in temperature and humidity control, so that different groups of fruits and vegetables can be stored. The company plans to store apples and plums initially. These products are compatible for storage. Ideal temperatures for both are -1°C to 1°C, Relative humidity should be 90% to 95%, and both are ethylene sensitive.

Iveria will use ICES, an experienced cold storage contractor to construct the facility. We visited ICES and their refrigeration contractor, Climate, who are based in Tbilisi.

We were favorably impressed with the contractor's knowledge and experience and the quality of their already constructed cold storage facilities. Iveria plans to purchase and sell apples in 2014. They will purchase, store, and resell apples in 2015. It is important for them to purchase good quality fruit, so they need to put into place a good purchasing strategy to guarantee good quality. Purchased apples should be cleaned and graded if necessary. They will become more profitable when they start selling their own apples.

Training should be provided for their employees in proper storage practices. Suppliers should also be trained in good agricultural management practices, good irrigation practices, good harvesting practices and postharvest management to insure that good quality produce will be provided.

There are two other cold storage facilities in the area. This will not be a problem for the success of this project, since Iveria will be storing and selling their own produce, significantly reducing there operational costs. Iveria has a well thought out plan to construct the cold storage facility. Comments are:

- The cold storage room will be constructed with urethane panels for the walls and ceiling. Urethane is the best insulation to use for this application and the insulated panels provide an excellent finish – inside the room and the outside wall.
- They will install humidifiers in each room to control the humidity. It is important to install a humidity control system that is easy to maintain. Maintenance and calibration instructions should be provided with the humidifier. The system will require clean filtered water, which should be available in the facility.
- Apples produce ethylene gas, so it is absolutely necessary to install ethylene gas vents at the ceiling level or an ethylene gas removal system. The ethylene levels in the rooms should be monitored regularly, so as to prevent premature ripening of the stored apples.
- Manual horizontal sliding doors will be installed in the cooling facility. The doors should be wide enough to allow palletized products to be moved in and out of the rooms with either pallet jacks or a small fork lift. It is recommended that good quality strip curtains be installed on the doors to reduce infiltration of warm air into the cold storage rooms. It is important to keep strip curtains maintained and replace them I they become damaged.
- If boxes or crates are to be hand carried in and out of the cold storage room frequently, a swing type door should be installed in addition to the horizontal sliding door to reduce infiltration of warm air into the cold storage room.

The following information should be provided to the refrigeration contractor for proper design of the refrigeration system:

- Product information
  - Apples, plums, and other products that Iveria may eventually store in the cold storage facility
  - Room temperature and humidity requirements (see above)
  - Temperature of incoming product during harvest
  - How much product will be coming into the room daily during peak harvest
  - The contractor shall train an Iveria employee on preventative maintenance and should provide a written preventative maintenance schedule and procedures for each piece of equipment.
- If pre cooling will be done inside one of the rooms, the refrigeration contractor will need to know how much product will be pre cooled daily.

Georgia Business Zone, Ltd.

Georgia Business Zone (GBZ) owns a dairy and in 2013 sold approximately 80 metric tons of cheese. In 2011 they started planting apple orchards on a 3 hectare land plot. In 2013, they established another apple orchard on a 1.5 hectare land plot, they planted 3500 apple trees grafted on M9 dwarf rootstocks, including Idared, Jonagold, Granny Smith, Mutsu, Golden Delicious, Fuji, Red Delicious and other cultivars. In 2013 they harvested an initial crop of 10 tons of various cultivars. In 2014 they expect to harvest 30 tons. They expect to harvest 180-200 tons of apples in 2016. They own a nursery and plan to expand the apple orchards annually using their nursery transplants.

One of the founders, Zaur Neparidze, was chief agronomist and a director for one of the sections in the state nursery. In addition, they have another agronomist, two staff members are trained in agriculture, and an experienced team of seasonal workers for harvest. They have experience in applying fertilizers and pesticides in the orchards.

GBZ is ISO 14000, ISO 2800, and HACCP certified, which will be very beneficial in marketing their products. They currently market products to a substantial list of consumers and plan to approach the same entities when marketing their apples. They have a good reputation and label recognition with their clients. In 2010 GBZ was awarded by the Georgia Chamber of Commerce of Industry and Trade as the Best AgriFirm among small and medium enterprises.

The company became profitable in 2013. This project will become very profitable in 2016 when they start harvesting 180-200 tons of apples from their orchards. They will purchase and sell apples until they have harvests sufficient to fill the cold storage facility. The company has the expertise to purchase good quality apples and should train their staff on good quality purchasing and postharvest management of apples. The company has been receiving at least GEL 1 for apples over the last 3 years, while apples stored in the cold storage facility and sold in winter and spring will sell for GEL 2-2.5.

WFLO reviewed GBZ's floor plan and detailed estimate. Comments are as follows:

- They plan to build a cold storage with 3 cold storage rooms with 60 ton capacity each and a large enclosed dock will serve both as a receiving and shipping dock. There is sufficient area for a processing line on the dock, which will sort, grade, and wash the received apples.
- The cold storage facility will be constructed with block walls that will be plastered inside and outside. Urethane insulated panel walls, ceiling and floor are included in the estimate. It is not recommended to use insulated panels for the floor as pallet jacks and small fork lifts will not be

able to load and unload the rooms. Using floor insulation is not required in a cooler for fruits. Floor insulation may be installed under the concrete floor if desired.

- The company has a good source of electrical power and 2 wells for potable water on their site.
- The company plans to install Techno Block refrigeration equipment from Italy – which is a good refrigeration equipment manufacturer.
- They will install humidifiers in each room to control the humidity. It is important to install a humidity control system that is easy to maintain. Maintenance and calibration instructions should be provided by the humidifier manufacturer. The humidification system will require clean filtered water, which should be available in the facility.
- Apples produce ethylene gas, so it is absolutely necessary to install ethylene gas vents at the ceiling level or an ethylene gas removal system. The ethylene levels in the rooms should be monitored regularly, so as to prevent premature ripening of the stored apples.
- The estimate indicates 2000 mm x 2000 mm horizontal sliding doors will be installed. It is recommended to install 2000 mm wide x 2500 mm high doors so as to allow use of fork lifts in the future if desired. It is recommended that good quality strip curtains be installed on the doors to reduce infiltration of warm air into the cold storage rooms. It is important to keep strip curtains maintained and replace them if they become damaged.
- If boxes or crates are to be hand carried in and out of the cold storage room frequently, a swing type door should be installed in addition to the horizontal sliding door to reduce infiltration of warm air into the cold storage room.

The following information should be provided to the refrigeration contractor for proper design of the refrigeration system:

- Product information
  - Apples and other products that GBZ may eventually store in the cold storage facility
  - Room temperature and humidity requirements (see above)
  - Temperature of incoming product during harvest
  - How much product will be coming into the room daily during peak harvest
  - The contractor shall train an employee on preventative maintenance and should provide a written preventative maintenance schedule and procedures for each piece of equipment.

If pre cooling will be done inside one of the rooms, the refrigeration contractor will need to know how much product will be pre cooled daily during the harvest season.

ANNEX III: **TRIP AND MEETING NOTES**

REAP Meeting

Date: April 8, 2014 **Attendees:** Faoro, Namicheishvili, Kobakhidze, Salukvadze, Bregadze, Hell, Dowdell

Location: REAP Office, Tbilisi
Purpose: Review Scope of Work
Reviewed:

- Project background
- Objectives
- Responsibilities
- Deliverables
- Visit and meeting agenda

Meeting with Grant Applicants

Date: April 8, 2014 **Attendees:** Dzneladze, Mindia, Zambakhidze, Makalatia, Salukvadze, Bregadze, Hell, Dowdell

Location: REAP Office, Tbilisi
Purpose: Review 3 Grant Applications
Comments:

- Reviewed grant applications from Geoflower, Iveria, and Georgia Business Zone
- The proposals were well written and contained relevant information
- Discussed the business plans with each applicant
- Each applicant is developing their own orchards to be stored in their cold storage facilities
- All plan to store in cold storage to extend the produce shelf life and maintain quality
- A follow up meeting is scheduled to review building plans on April 17

Meeting with Industrial Construction Solutions (ICES)

Date: April 8, 2014 **Attendees:** Iakobashvili, Salukvadze, Bregadze, Hell, Dowdell

Location: ICES Office, Tbilisi
Purpose: Review ICES Qualifications
Comments:

- ICE specializes in design/build cold storage construction – they provide complete turnkey services
- They have the knowledge to assist owners in layout and floor plans
- They use good practices and materials in the cold storage facilities

- Gocha Iakobashvili has an excellent working knowledge of the requirements for fruit and vegetable storage including temperature and humidity control as well as the need to ventilate rooms that produce ethylene gas
- He has a good working knowledge of truck dock requirements and site layout for receiving and shipping products

Meeting with Albert Machaberidze

Date: April 8, 2014 Attendees: Machaberidze, Salukvadze, Bregadze, Hell, Dowdell

Location: REAP Office, Tbilisi
Purpose: Review Trainer Qualifications of Albert Machaberidze
Comments:

- Has good formal education in postharvest training
- Has good practical experience in postharvest operations
- Probably would be a very good trainer for in the field application
- May not be a strong class room trainer
- He has another commitment and might not be available for 8 months

Visit to Kachreti Vocational College

Date: April 10, 2014 Attendees: Papumashvili, Salukvadze, Bregadze, Hell, Dowdell

Location: Kachreti Region
Purpose: Evaluate Kachreti Vocational College for Training
Comments:

- The facilities are very good
- Kachreti is a 2 year school that provides short term courses targeted at the needs in the area
- There are 312 students. They conduct morning and afternoon classes
- The school specializes in artificial insemination for cattle and has classes for food processing
- There is a small walk in cooler on the campus
- The school would be a good location for postharvest training classes, but it is suggested that a technical trainer be hired for the training
- There does not appear to be many cold storage facilities in the area. This may not be a good venue for cold storage training. A survey of local cold storage facilities should be made to determine how many students would be interested in cold storage training

Visit to Cold Storage Facility in Akhasheni Region

Date: April 10, 2014 Attendees: Salukvadze, Bregadze, Hell, Dowdell

Location: Akhasheni Region
Purpose: Assess Cold Storage Facility
Comments:

- We were not able to get access to the inside of the facility. It was in a seasonal shut down.

- The facility is 150 MT capacity with 3 cold storage rooms and a process room.
- It has a 4m x 20 meter open dock with accommodations for highway trucks.
- It is well built with urethane insulated panels and has Techno Block refrigeration equipment.
- The exterior needs some flashing and gutter work to avoid water getting above the insulated panel ceiling and on the covered dock.
- They store peaches, apples, pears, strawberries, and grapes.

Visit to a 2nd Cold Storage Facility in Akhasheni Region

Date: April 10, 2014 **Attendees:** Salukvadze, Bregadze, Hell, Dowdell

Location: Akhasheni Region
Purpose: Assess Cold Storage Facility
Comments:

- This cold storage facility was built under the Millennium Challenge Georgia Fund
- There are 4 cold storage rooms and an unrefrigerated dock. It has a humidification equipment for humidity control
- It is a good facility, but was not being used for cold storage at the time of our visit
- The dock has only 1 door. It was not designed to facilitate receiving and shipping product

Visit to Gantiadi Vocational College

Date: April 11, 2014 **Attendees:** Dabrundashvili, Salukvadze, Bregadze, Hell, Dowdell

Location: Gori
Purpose: Evaluate Gantiadi Vocational College for Training
Comments:

- We met with Otar Dabrundashvili, an administrator for the college. We did not meet with instructors, he indicated they have staff who can teach training classes
- The facility is good.
- It is a good venue because there are many orchards and cold storage facilities in the area.

Visit to Iveria Orchard

Date: April 11, 2014 **Attendees:** Makalatia, Salukvadze, Bregadze, Hell, Dowdell

Location: Gori
Purpose: Visit Iveria Orchard and Site for Cold Storage facility
Comments:

- We met with Nino Makalatia at his orchard and site of the new cold storage facility
- It is an excellent site with a good road to the property. They have installed a 10 kW power line to the property. They have good water available.
- Iveria started planting orchards in 2011. The have planted some high density orchards.
- They were installing a modern irrigation system during our visit.
- They will use ICES to construct a 250 MT cold storage facility with 4 cold storage rooms.

Visit to a Cold Storage Facility in Gori Region

Date: April 11, 2014 **Attendees:** Salukvadze, Bregadze, Hell, Dowdell

Location: Gori Region
Purpose: Assess Cold Storage Facility
Comments:

- This cold storage facility is well built and has 4 Controlled Atmosphere (CA) rooms. The facility was in seasonal shutdown during our visit.
- There is a process room with sortation equipment
- It has a recessed truck well so that highway trucks may be loaded with a fork lift
- They own an 18 wheel refrigerated truck

Visit to Akaki Tsereteli State University

Date: April 14, 2014 **Attendees:** Kintsurashvili, Salukvadze, Bregadze, Hell, Dowdell

Location: Kutaisi
Purpose: Evaluate Akaki Tsereteli State University for Training
Comments:

- We met with Ketevan Kintsurashvili and about 12 instructors.
- The instructors have excellent credentials including postharvest training, electrical, and refrigerator and air conditioning equipment.
- One of the instructors recently wrote a technical book on refrigeration systems
- The university has the capability to provide complete training on postharvest and refrigeration systems
- The facility is good and it is located in a large farming area.

Visit to a Herbia

Date: April 14, 2014 **Attendees:** Janelidze, Salukvadze, Bregadze, Hell, Dowdell

Location: Geguti Region
Purpose: Assess Cold Storage Facility
Comments:

- Herbia sells herbs in the European and local markets
- Have 2.5 hectare greenhouse
- Facility has 2 cold rooms and a pre-cool room
- Dock is truck trailer height
- Need to install a door between pre-cool room and holding cooler to improve operations
- Have a backup generator

Visit to Batumi Shota Rustaveli University

Date: April 15, 2014 **Attendees:** Megrelidze, Salukvadze, Bregadze, Hell, Dowdell

Location: Mtsvane Kontskhi
Purpose: Evaluate Batumi Shota Rustaveli University for Training
Comments:

- We met with Merab Megrelidze and 4 staff members
- The facility is in a remote location and appears to be used very little
- This is not a good venue for training programs

Visit to Agroexporti

Date: April 15, 2014 **Attendees:** Surmanidze, Bregadze, Hell, Dowdell
Location: Batumi Region
Purpose: Assess Cold Storage Facility
Comments:

- Agroexporti exports citrus, tea and persimmon to Ukraine and Russia
- They have 2 cold rooms and a process room
- They plan to install a box making machine to meet their box requirements and a consolidation/processing facility
- They process mandarins and persimmons
- Overall this seems to be a well-run business, with very good technical competence

Visit to Guria ABC

Date: April 15, 2014 **Attendees:** Mameshvili, Bregadze, Hell, Dowdell
Location: Ozurgeti Region
Purpose: Assess Cold Storage Facility
Comments:

- Guria has a small cooler that has storage racks
- The refrigeration system uses 16 small evaporators in the cold room
- Guria wants to lower the temperatures to -1C, but can't as the evaporators are not equipped with defrost. Suggest they replace the 16 small evaporators with 2 larger evaporators with electric defrost
- Guria has a grading and sorting line
- They store mandarins, citrus, persimmons, black berries, blue berries, and kiwi.

Visit to Roadside Market

Date: April 16, 2014 **Attendees: Bregadze, Hell, Dowdell**
Location: Batumi Region
Purpose: Discuss storage and product loss
Comments:

- Farmer was selling apples, kiwi, and mandarins

- He stores in a cellar which would be about 13C
- He is experiencing 40% to 50% product loss

Power Point Presentation

Date: April 17, 2014 **Attendees:** Kumsishvili, Faoro, Namicheishvili, Kobakhidze, Salukvadze, Bregadze, Hell, Dowdell

Location: REAP Office, Tbilisi
Purpose: Preliminary Review of findings
Reviewed:

- Visits to vocational colleges and universities
- Issues found at cold storage facilities
- Outline of proposed training modules

Visit to Cold Storage Facility

Date: April 17, 2014 **Attendees:** Morchiladze, Bregadze, Hell, Dowdell
Location: Tbilisi
Purpose: Assess Cold Storage Facility
Comments:

- Visited a cold storage with Mamuka Morchiladze of Climate
- The cold storage is rented to vendors
- The cold rooms are excellent
- There is a long narrow dock outside the storage rooms
- Truck access is difficult

Visit to Cold Storage Facility

Date: April 17, 2014 **Attendees:** Morchiladze, Bregadze, Hell, Dowdell

Location: Tbilisi
Purpose: Assess Cold Storage Facility
Comments:

- Visited a cold storage near the airport with Mamuka Morchiladze of Climate
- The cold storage rooms are rented to vendors
- The cold rooms were built under a concrete structure
- The truck dock has dock levelers

Meeting with Grant Applicants

Date: April 17, 2014 **Attendees:** Dzneladze, Mindia, Zambakhidze, Makalatia, Salukvadze, Bregadze, Hell, Dowdell

Location: REAP Office, Tbilisi

Purpose: Review floor plan of the 3 Grant Applicants

Comments:

- Reviewed floor plans for Geoflower, Iveria, and Georgia Business Zone
- Provided recommendations to the applicants

Visit and Meeting List

Organization	Date	Topic	Participants	Comments
REAP	4/8/14	Meetings to Review SOW, Objectives, Duties and Responsibilities, Related Meetings, and Deliverables	Faoro Namicheishvili Kobakhidze Salukvadze Bregadze Hell Dowdell	Initial meeting to review the REAP project including the background, objectives, responsibilities, and deliverables
Geoflower Georgia Business Zone, Iveria	4/8/14	Review grant applicant proposals	Dzneladze Mindia Zambakhidze Makalatia Salukvadze Bregadze Hell Dowdell	Reviewed proposals from 3 applicants
ICES	4/8/14	Meet with cold storage contractor	Iakobashvili Salukvadze Bregadze Hell Dowdell	ICES specializes in design-build cold storage facility construction
Individual Consultant	4/8/14	Interview for prospective training program	Machaberidze	Reviewed Albert Machaberidze's qualifications for training

		instructor	Salukvadze Bregadze Hell Dowdell	program instructor
Kachreti Vocational College	4/10/14	Assess training opportunities	Papumashvili Salukvadze Bregadze Hell Dowdell	College provides training in agriculture and food processing
Cold Storage Facility	4/10/14	Visit cold storage facility	Giorgadze Salukvadze Bregadze Hell Dowdell	Facility was shut down for the season
Cold Storage Facility	4/10/14	Visit cold storage facility	Salukvadze Bregadze Hell Dowdell	Facility was built as part of the Millennium Project
Gantiadi Vocational College	4/11/14	Assess training opportunities	Dabrundashvili Salukvadze Bregadze Hell Dowdell	College provides diversified classes and training
Iveria, Ltd.	4/11/14	Visit orchard and cold storage site	Makalatia Salukvadze	Excellent orchard and future cold storage facility site

			Bregadze Hell Dowdell	
Cold Storage Facility	4/11/14	Cold Storage Facility	Salukvadze Bregadze Hell Dowdell	Visit cold storage facility with Controlled Atmosphere (CA) Rooms
Akaki Tsereteli State University	4/14/14	Assess training opportunities	Kintsurashvili Salukvadze Bregadze Hell Dowdell	Excellent facility with a good diversified staff
Herbia	4/14/14	Cold Storage Facility	Janelidze Salukvadze Bregadze Hell Dowdell	Cold storage facility to store herbs, has a pre-cool room
Batumi Shota Rustaveli University	4/15/14	Assess training opportunities	Megrelidze Salukvadze Bregadze Hell Dowdell	Remote location, the facility appears to have limited use
Agroexporti, Ltd.	4/15/14	Processing and cold storage facility	Sarmanidze Salukvadze	Good processing area and cold storage facility

			Bregadze Hell Dowdell	
Guria ABC	4/15/14	Processing and cold storage facility	Mameshvili Salukvadze Bregadze Hell Dowdell	Good cold storage facility with storage racks
Roadside market	4/16/14	Visit fruit market	Bregadze Hell Dowdell	Discussed storage with farmer
Power Point Presentation	4/17/14	Present draft of findings from visits	Kumsishvili Faoro Namicheishvili Kobakhidze Salukvadze Bregadze Hell Dowdell	Present outline of findings and outlines of proposed training courses
Cold Storage Facility in Tbilisi	4/17/14	Visited cold storage facility with Climate	Morchiadze Bregadze Hell Dowdell	Climate installed the refrigeration systems
Cold Storage Facility near airport	4/17/14	Visited cold storage facility with Climate	Morchiadze Bregadze	Climate installed the refrigeration systems

			Hell Dowdell	
Geoflower Georgia Business Zone, Iveria	4/17/14	Reviewed floor plans for cold storage facilities	Dzneladze Mindia Zambakhidze Makalatia Bregadze Hell Dowdell	Reviewed and discussed floor plans and details of proposed construction

ANNEX IV: APPLE AND PLUM STORAGE RECOMMENDATIONS

Harvesting and Handling

To ensure maximum storage life, apples should be harvested when mature but not yet fully ripe or overripe. If harvested before they have matured, apples will have poor eating quality, will be more susceptible to storage disorders such as scald, cork spot, and bitter pit, and may not ripen properly. Ripe fruits should be avoided because they will continue to ripen in storage, rapidly becoming too soft and mealy for sale. Firmness and the level of soluble solids which can be measured with a refractometer in the apple are good indicators of maturity to use in determining picking time. Maturity indices differ with variety of apple:

Gala – Ground color change from green to light-green or white may be the most useful indicator of maturity for harvesters

Golden delicious - Generally about 135 to 150 days from full bloom.

Fuji - •Ground color change from green to light-green or white may provide a useful indicator for harvest, harvest about 180-190 days after full bloom.

Apples are very susceptible to bruising and other forms of mechanical damage and should not be handled any more than necessary. Workers harvesting apples should be cautioned not to drop them or handle them roughly. The effects of bruising and scuffing cannot be reversed. Damage from rough handling will accelerate deterioration, reducing the value of the product.

Apples should be filled in bulk boxes in the orchard. Full boxes should not be allowed to sit for extended periods in direct sunlight nor for more than a few hours before cooling is started. They also should not be overfilled. When overfilled boxes are stacked, many apples throughout the box are bruised.

Bulk boxes should be kept clean and in good repair and should be stored indoors when not in use. Most bulk boxes made from hardwood have enough open space between the individual boards in the bottom and sides to ensure adequate air circulation and water drainage. Also plastic crates can be used for transport and storage of apples, similarly there is need to assure that the crates allow good ventilation.

Chemical Treatments

Harvested apples are often treated with chemicals, dip or spray treatments to inhibit storage disorders if such chemicals are authorized for use in Georgia. A good aqueous solution is made of 3 percent calcium chloride plus a scald inhibitor mixed with a surfactant and fungicides.

Cooling and Storage

An apple continues to live and respire even after it is picked. Although respiration cannot be halted completely, the objective of postharvest cooling is to slow the process and thus increase storage life.

Even if apples are to be stored for only a short period, it is still very important that the field heat be removed from them as soon as possible.

Optimum Temperature for Storage

The higher the holding temperature, the greater the softening and respiration rate and the sooner the quality becomes unacceptable.

0°C ± 1°C; Freezing temperature: -1.7°C

Optimum Relative Humidity in Storage

All varieties require a relative humidity from 90 to 95 percent, which may require adding water vapor to the air in the storage room with one or more humidifiers. Maintaining the humidity within this range will reduce weight loss, but humidity near the saturation point (100 percent) will encourage the growth of bacteria and fungi.

Rates of Respiration[1]

Temperature	0°C	5°C	10°C	20°C
ml CO_2/kg·hr	3-6	4-8	7-12	15-30

[1] Higher rates for riper apples.

Rates of Ethylene Production[2]

Temperature	0°C	5°C	10°C	20°C
µl/kg·hr	1-10	2-25	5-60	20-150

[2]Higher rates for riper apples.

Chilled apples that are suddenly transferred into warm air are likely to "sweat" - that is, water vapor in the air will condense on them. Sweating also occurs when the doors of a cold storage room are opened, allowing warm, moist air to enter. Sweating itself does not harm the fruit, but it causes wetting, which encourages the growth of fungi and bacteria. Chilled apples should not be allowed to warm and then be rechilled. To prevent sweating, allow chilled apples to warm gradually inside the storage area, if possible, before bringing them out into the open air.

Since apples are stored longer than many other types of produce, it is essential that both the storage rooms and containers be clean and sanitary. Storage rooms should be thoroughly cleaned before they are filled. If molds are found to be growing in the storage room, the interior surfaces may be disinfected with a 0.25 percent solution of sodium hypochlorite applied with a high-pressure washer. Surfaces should be allowed to air dry for several days.

Refrigeration coils, fans, and ducts should also be inspected and cleaned regularly. Refrigeration coils are especially likely to become clogged with dust and dirt that will substantially decrease their thermal efficiency. It is also a good idea to check all interior and exterior surfaces periodically for air leaks and damaged insulation. Door gaskets should be checked for a good seal by inserting a sheet of paper between the door and the frame, closing the door, and then attempting to pull the paper out. If it slips out easily, the gasket should be replaced or adjusted.

Plum Storage

Harvesting and Handling

In most plum cultivars, harvest date is determined by skin color changes that are described for each cultivar. Firmness, measured by squeezing fruit in the palm of the hand ("spring"), is also a useful maturity index.

Flesh firmness, measured using a penetrometer (8-mm tip), can be used to determine a maximum maturity index, which is the stage at which fruit can be harvested without suffering bruising damage during postharvest handling. Plums are less susceptible to bruising than most peach and nectarine cultivars at comparable firmness.

Fresh prunes are picked on the basis of color, ie., at least 50% of the fruit surface is red or purple.

Grades, Sizes and Packaging: Plums and fresh prunes are hand-picked into bags, then dumped in bins that are moved on trailers between tree rows in the orchard. At the packinghouse, plums are washed. Sorting is done to eliminate fruit with visual defects and sometimes to divert fruit of high surface color. Sizing segregates fruit either by weight or dimension.

Pre-cooling Conditions: Plums and fresh prunes can be cooled in field bins using forced-air cooling, hydro-cooling, or room-cooling prior to packing. Packed plums and fresh prunes should be cooled by forced-air cooling to near 0 °C.

Optimum Storage Conditions: A storage temperature of -1.1 to 0 °C with 90 to 95% RH should be used. An air circulation velocity of approximately 15 m3/min is suggested. The freezing point varies from -2 to -1 °C (28.4 to 30.2 °F) depending on Soluble Sugar Content.